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Dear Dr. Louie:

We greatly appreciate the opportunity to respond to questions raised about our above-referenced proposal. To review, the goal of this research is to study the housing affordability "treatment effect" of federally assisted housing, which has been ignored as a marker of inequality by economic status and which introduces housing policy as a novel policy lever to improve youth outcomes.

The investigators used reviewers' comments as a springboard and identified ways to strengthen the proposed research.

The Foundation and reviewers' thoughtful comments have inspired us to enhance our proposal with two additional analyses: one that extends the time period so we can examine outcomes when children reach young adulthood, and another that more directly isolates the affordability component of federally assisted housing. (Below, we refer to the first new analysis as the "time extension" analysis, and to the second as the "assisted housing affordability" analysis.)

The PIs prioritize the most critical concerns.

We begin with responses to the items listed in your July 17 cover letter, followed by our responses to Reviewer #1 and then to Reviewer #2.

Cover Letter

Q. 1(a): Clarify the relationship between the proposed work and earlier work.

A. 1(a): Our previous research (Newman & Holupka 2015a; 2015b) focuses on households with children living in the *private housing market*. The proposed research focuses on households with children living in *assisted housing*, that is, public housing, privately owned housing receiving government funding, and housing vouchers.

The previous research on private market housing established the foundation for the proposed study by demonstrating that housing affordability has beneficial effects on children's cognitive

performance and by identifying that one mechanism for these beneficial effects is greater expenditures on child enrichment by parents who live in affordable housing in the private market. The proposed research on assisted housing will test whether these results generalize to households in assisted housing, where affordability is essentially guaranteed. If so, there are direct implications for using assisted housing as a policy lever to address child, youth and young adult inequality.

The PIs provide a general statement about how the proposed study extends prior work.

Q. 1(b): Clearly state how the project will advance the field empirically, conceptually, and methodologically.

A. 1(b): Empirical contributions. In addition to our response to Q.1(a) just noted, this study will be the first analysis of the updated Panel Study of Income Dynamics-Assisted Housing Database (PSID-AHD), in which assisted housing addresses have been matched to PSID sample addresses through the 2000 decade. It will also be the first examination of the effects of the affordability mechanism of assisted housing on the 2007 adolescent outcomes of children who lived in assisted housing during their early or middle childhood years and, in the time-extension additional analysis we propose here, the 2013 young adult outcomes of the same sample of assisted housing children. Third, it will be the first study of individual outcomes of assisted housing using a nationally representative sample (a cumulative total of seven cities have been included in the three strongest studies to date). Finally, the additional assisted housing affordability analysis we now propose will be the first effort to directly isolate the affordability element of assisted housing.

The PIs respond point by point to demonstrate how the proposed study adds empirical, conceptual, and methodological contributions beyond existing work.

Conceptual contributions. This research will be the first to examine the effects of the housing affordability mechanism of assisted housing on adolescent and young adult outcomes. As explained in the proposal, the replication of results from previous well-designed research, including two experiments, has produced the consensus view that assisted housing primarily addresses the problem of housing affordability and has little if any measurable effect on either housing or neighborhood quality. (Also see our response to Q. 4(b) below.)

However, our proposal does not accept this premise at face value. We include two analytic steps to isolate the affordability component of assisted housing, thereby verifying its central role. First, in multivariate models, we will control for detailed measures of housing cost burden for children who lived in assisted housing and for those who did not. For the assisted housing group, these measures are necessary in order to account for the complex rules that apply to assisted housing programs,[1] and for the considerable discretion given to the more than 3,900 local PHAs over components of housing costs such as utilities (e.g., allowances; surcharges). In addition, we have been granted

The thoughtful and detailed discussion of the issues at hand demonstrate deep understanding and provide context for the PIs response.

[1] One example is that after one year, a voucher household is allowed to spend more than 30 percent of income for rent. This provision was designed to give the household discretion over its housing choices and to enable it to upgrade its housing unit and neighborhood.

access to HUD administrative data including assessments of physical housing quality and of overall management of assisted units by the local PHA. We are, therefore, able to use these measures as an additional test of the relative contribution of housing affordability to adolescent outcomes. Further, we will use a wide array of neighborhood quality measures to similarly confirm the relative importance of affordability vis a vis the neighborhood context. Beyond these two steps included in our submitted proposal, we now propose a third analysis, which we describe below in our response to the second question raised in your cover letter.

In addition, this will be the first study to rigorously test the three leading hypotheses for the role of assisted housing, via its effect on affordability, in adolescent and young adult outcomes. These are: (1) the conventional hypothesis that assisted housing affordability provides the family with greater discretionary income that can be devoted, at least in part, to child enrichment expenditures, and that may reduce parental stress, with beneficial consequences for children via better parenting and greater housing stability; (2) the obverse hypothesis that assisted housing affordability eliminates the possibility that too little will be spent on housing, thereby leading to inadequate housing in a poor quality location; and (3) the community amenities/disamenities hypothesis that higher-priced housing, and therefore housing that is less affordable to lower-income families, purchases a richer array of community resources that could be beneficial to child development.

Methodological contributions. As discussed below in our response to Reviewer #2, Question 1, although there is a substantial research literature on the effects of assisted housing on its residents, less than a handful of studies use an appropriate research design and analytic approach. Moreover, none of these well-designed studies focuses on adolescent outcomes or uses nationally representative survey data.

The study also will be the first to apply two analytic techniques, propensity score modeling (PM) and instrumental variables (IV), to adjust for omitted variable bias in estimating the role of assisted housing's affordability in adolescent outcomes. Because there are multiple conceptual and empirical options in using both the PM and IV techniques, the rationale for our choices among the alternatives and the results they produce will provide useful information for the field.

The application of structural equation modeling (SEM) to this context also is methodologically innovative. None of the three rigorous studies on assisted housing effects mentioned earlier[2] apply SEM. Our use of this technique would, therefore, present a different analytic approach. (We also greatly appreciate Reviewer #1's comment that our SEM approach is "quite competent.")

Q. 2 (a): Why are nonlinear effects excluded from the proposed models? (b) Clarify the mechanisms through which spending too little on housing may negatively impact children; (c) Clarify the relationship between assistance and affordability, and how the proposed study goes beyond assessing the impact of assistance alone.

[2] These are discussed in more detail below in response to Reviewer #2, Q. 1.

Several review comments persuade us that it is desirable to add a more direct approach for isolating the affordability aspects of assisted housing and to examine whether we detect the same curvilinear effects we found in our previous work (Newman & Holupka 2015a; 2015b). In response, we propose to include a new analysis that explicitly examines the affordability and potential nonlinearity of assisted housing. This new assisted housing affordability analysis should further clarify the relationship between housing assistance and affordability, and provide insights into the mechanisms through which a high housing cost burden (i.e., spending considerably more than the rule-of-thumb of 30 percent of income) or a low housing cost burden (i.e., spending considerably less than 30 percent) affects the adolescent and young adult outcomes of those who lived in assisted housing during childhood.

The PIs add a new analysis in response to reviewers' concerns. In the following sentences, they also explain the value of the new analysis.

Operationally, we will separate the comparison sample of children not living in assisted housing into three groups: (1) those living in families with high housing cost burdens (the "unaffordable" group); (2) those with reasonable housing cost burdens (the "affordable" group); and (3) those with low housing cost burdens who, because of their modest incomes, are deemed to be spending too little on housing. This disaggregation of the comparison group into three subgroups allows us to directly test for nonlinearities across the housing cost distribution.

The PIs offer a plan and concrete steps for carrying out the work.

We expect to find similar outcomes between the assisted housing group and the subgroup who never lived in assisted housing, but who did live in affordable private market housing during childhood. By contrast, children living in assisted housing should experience better outcomes than both the high housing cost burden and low housing cost burden subgroups in the unassisted housing sample. We will account for selection and omitted variable bias in this additional investigation using the same statistical approaches detailed in our original proposal (PM, IV, and SEM). The SEM will allow us to identify the mechanism(s) that produce the differential effects on adolescent and young adult outcomes by level of housing affordability, such as differences in child enrichment expenditures.

Q3. –-Omitted---

Q. 4(a): Justify the ability of the IV approach to adequately address omitted variable bias.

A. 4(a): We fully agree with the implicit concern of this reviewer that identifying a suitable IV that adequately addresses omitted variable bias (Q. 4a) and does not violate the exclusion principle (Q. 4b) is a great challenge in any analysis. Our proposed study is no exception. One of the fundamental features of assisted housing programs that works to our advantage is that assisted housing is not an entitlement but a rationed benefit. Therefore, there is at least some element of chance in determining who among the lower income population receives it.[3] This is

[3] Others who have used this element of chance to statistically identify their models include Jacob & Ludwig (2012), Jacob et al. (2013), and Jacob et al. (2015).

why receipt of assisted housing is often compared to a lottery. The concern that unmeasured attributes such as resourcefulness and initiative determine who will apply for and receive assistance is largely mitigated by the income targeting rules governing the programs. These rules became more stringent over the years of observation for our analysis. As a result, the majority of assisted housing households with children receive some form of welfare, which makes it very likely that they were connected to assisted housing through the welfare system. Finally, the PSID and its Child Development Supplement (CDS) provide a wealth of measures of family characteristics including parent education, employment, and self-efficacy, which are correlated with unmeasured traits such as resourcefulness. These and many other characteristics will be included as control variables in modeling.

A frank discussion of the analytic strategy's limitations suggests the PIs have a nuanced understanding of the proposed approach.

Nonetheless, one cannot completely eliminate concerns about omitted variable bias. Therefore, we will also conduct sensitivity tests to determine the robustness of results to this source of bias. For the PM and IV models, we will use an approach developed by VanderWeele and Arah (2001). For the SEM, we will use phantom variable analysis (Hancock & Harring 2011).

Q. 4(b): Clarify how the IV meets the exclusion restriction.

A. 4(b): It is completely logical to assume that housing assistance affects housing and neighborhood quality, and that these effects would, in turn, have independent and direct effects on child outcomes. If true, then our proposed IV would violate the exclusion restriction because these effects were not mediated by housing affordability. However, the most rigorous studies of assisted housing effects to date find no substantively meaningful or statistically significant differences in housing or neighborhood quality between those receiving housing assistance and comparably poor households. For example, Jacob (2004), Mills et al. (2006) and Carlson et al. (2012) conducted intensive comparative analyses of multiple measures of neighborhood quality among housing assistance recipients and comparable non-recipients, and concluded that assisted housing receipt had little effect on neighborhood quality. The consistent result of the best studies, therefore, is the absence of housing and neighborhood quality effects. This provides part of the empirical grounding for our assumption that the effects of housing assistance on adolescent and young adult outcomes should operate through its effect on housing affordability.

The PIs propose a sophisticated set of sensitivity analyses in response to reviewers' concerns around whether the assumptions behind the instrumental variable analysis will hold up.

Finally, although it is impossible to statistically establish that an IV meets the exclusion principle, several statistical techniques have recently been developed that will allow us to test the sensitivity of the IV results to possible violations of the exclusion restriction (e.g., Kraay 2012; Conley et al. 2012; Riquelme et al. 2013). These tests are similar in spirit to the sensitivity tests for omitted variable bias described in response to Q. 4(a). In fact, Riquelme et al. (2013) have already developed a Stata command that estimates their "Fractionally Resampled Anderson Rubin" test. These sensitivity tests will estimate the robustness of the results to violations of the exclusion restriction.

Q. 5: Is the time span of the analyses sufficient for effects on child outcomes to emerge?

A. 5: We agree with the review comments pushing us to expand our analysis to account for the provocative findings of Chetty et al. (2015). Chetty and colleagues reanalyzed data from the MTO experiment, and found that moving children up to age 13 to better neighborhoods positively affects their young adult education and income even in the absence of benefits at younger ages. We have, therefore, expanded our proposal to include responses to two questions raised by Chetty et al.: (1) Does the effect of housing assistance vary by child's age, and, in particular, are younger children more likely to benefit? and (2) Are there longer-term effects of housing assistance on young adult outcomes, regardless of any childhood effects? We can compare education attainment outcomes in young adulthood of those moving into assisted housing before and after age 13 because two-thirds of the assisted housing sample was living in assisted housing before age 13, and nearly all (96 percent) remained in the PSID until at least the age of 18. In addition, because the 2013 PSID data are now available, we will examine the education and income outcomes for approximately half of the analysis sample that is 21 or older by 2013 (the same age cutoff used by Chetty et al.). This analysis will compare the young adult outcomes of the assisted housing and non-assisted housing groups. We will also compare the outcomes of children who lived in assisted housing before age 13 to those who did not move into assisted housing until they reached age 13. This segment of the analysis is based on Chetty et al.'s finding of positive effects for children who moved in younger years and negative effects for those who moved as teenagers.

The PIs propose a second set of new analyses to respond to another set of reviewers' concerns.

Reviewer #1

Q. 1: Unfortunately the resulting hypothesis (i.e., spending too little on housing may be associated with poor outcomes) is not addressed in the analysis.

A. 1: See response to cover letter, A. 2(a).

Q. 2: Concern about the geographic level of community amenities/disamenities measures.

A. 2: We apologize for the lack of clarity in our description of how we will measure community features. In our attempt to be brief, we sacrificed clarity. The community measures to be included in the analyses will reflect different levels of geographic aggregation. For example, local public expenditures on such resources as libraries and parks will come from the Census of Government's data for the local government level that collects taxes to support these resources (e.g., city; county). Many communities try to locate these resources within catchment areas so that residents within the area have reasonably easy access to them. Crime data are also available at the city and county levels. Because housing prices theoretically capitalize all of the features of the location of the residence, we will also test models that include house prices. These data are available from commercial databases such as Zillow at the zip code level, and house value and rent (proxies for house prices) are available from the Census and American Community Survey

at the lowest aggregation of the census tract level and continuing through larger geographic areas.

Q.2/A.2 to Q.6/A.6 omitted

Reviewer #2

Q. 1: Many studies have evaluated the effects of various forms of housing assistance on youth outcomes.

A. 1: We agree with the reviewer that a substantial body of research has been developed over roughly three decades examining whether assisted housing affects children's outcomes. However, only three studies (Jacob 2004; Mills et al. 2006; Jacob et al. 2015) rely on two critical elements required for causal inference: the valid identification of assisted housing units, not self-reports, which are prone to serious misreporting; and a research design and analytic methods that address endogeneity, selection bias and omitted variable bias. The analytic challenge is accounting for the fact that children in assisted housing are likely to have a number of characteristics that the researcher does not observe. These omitted variables may be part of the reason for the estimated outcomes regardless of whether the child lived in assisted housing. This problem has prevented most studies from estimating the causal effect of assisted housing on children's outcomes. While these studies reveal the correlations between assisted housing residence and child outcomes, they do not estimate a causal relationship. Although the Jacob (2004), Mills et al. (2006), and Jacob et al. (2015) studies meet the criteria for causal inference, none focuses on whether the affordability of assisted housing yields beneficial effects on cognitive, noncognitive, and health outcomes in adolescence, the mechanism that facilitates these effects, and whether there are subgroup differences either in the effects of assisted housing affordability or in the pathway through which the effects are conveyed.

The PIs revisit the issue of the study's contribution and provide a concise statement about the current study's value.

Q.2/A.2 to Q.8/A.8 omitted
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